

Adaptable Dwellings

Prepared For:

U.S. Department of Housing and Urban Development
Office of Policy Development and Research

Under:

Contract H-2200 to Syracuse University

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The research and studies forming the basis for this report were conducted by Syracuse University pursuant to a contract with the U.S. Department of Housing and Urban Development (HUD) Office of Policy Development and Research. The statements and conclusions contained herein are those of the contractor and do not necessarily reflect the views of the U.S. Government in general or HUD in particular. Neither the United States nor HUD makes any warranty, expressed or implied, or assumes responsibility for the accuracy or completeness of the information herein.

FOREWORD

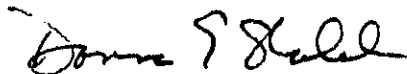
Over the last decades, Americans have been learning to see what we have never seen before. I refer not to flying saucers but to people -- people who have been hidden from us by prejudice, by custom, and by ignorance. Ralph Ellison described the phenomenon for blacks in his powerful novel, The Invisible Man.

Today, finally, we see the black population; we are only beginning to see other groups -- women, the American Indian, the elderly, the handicapped -- see them both as national resources and as groups having claims on the national conscience.

This publication is one of a series of six, the titles of which are listed in the acknowledgements, that HUD's Office of Policy Development and Research has sponsored to accomplish the important task of making buildings accessible to and usable by the physically handicapped through improving the American National Standards Institute's A117 standard.

Prepared under the supervision of the Office of Policy Development and Research, these volumes have won a research award from Progressive Architecture. To quote from the jury comments: "In terms of the effect that the work will have on future architecture and planning, the new ANSI standard A117.7 has got to be the blockbuster of all.....It's a very solid piece of work."

It is indeed. I am proud to present it to you.



Donna E. Shalala
Assistant Secretary
for Policy Development
and Research

Acknowledgements

We wish to thank the many people who contributed to the research and development of this report. In particular, Charles Gueli and Deborah Greenstein, Office of Policy Development and Research, HUD, who provided advice and assistance through their efforts as Government Technical Representatives for the contract. Finally, Jean Caraccilo, as the office secretary, provided immeasurable assistance through typing and day-to-day logistical support.

This report is one of a series of reports prepared under this contract. The full series includes:

1. Access to the Built Environment: A Review of Literature
2. Accessible Buildings for People with Walking and Reaching Limitations
3. Accessible Buildings for People with Severe Visual Impairments
4. The Estimated Cost of Accessible Buildings
5. A Cost Benefit Analysis of Accessibility
6. Adaptable Dwellings

All of this research contributed to the development of the proposed revisions to ANSI A117.1, Making Buildings and Facilities Accessible to and Usable by the Physically Handicapped.

Introduction

There are many design manuals, homemaking and personal care books and architectural barrier check lists that identify approaches toward usable housing for disabled people. While each source addresses itself to the issue of independent living, there are considerable differences in perspective among them. The homemaking or personal care manual typically concentrates on task-oriented rehabilitation. Adaptive devices and goals of task organization for homemaking and personal care are stressed over architectural or interior design criteria. Design manuals and check lists, on the other hand, do not deal with task organization or adaptive devices and stress architectural interior design features.

Most professionals and consumers would agree that independent living for disabled persons should combine a program of training, the use of adaptive devices and the construction of necessary architectural/interior design accommodations. But, the urgent needs of disabled citizens, the constraints of economics or legislative limitations and the concurrent lack of understanding of designers and product manufacturers about accessibility needs often result in a neglect of one or more of these three factors.

The development of an appropriate strategy of independent living must consider how training (including self-help), adaptive devices and architectural/interior design features can best be combined to support a disabled individual in independent living. This report is concerned with how disabled consumers view the use of adaptive devices and design features. The research described here sought to identify what parts of a dwelling should be designed for accessibility and to what extent special features were necessary, from the disabled person's point of view. The consumer's viewpoint must be considered in developing policy and design guidelines for accessible housing. This will insure that policy and guidelines will provide for consumers' needs, as they perceive them, and that economic resources can be allocated effectively to achieve accessibility. Although human performance abilities must dictate the actual design criteria for parts of a dwelling, consumer attitudes can help to identify the extent to which certain features are desirable and the best manner for them to be provided.

This report outlines how adaptive devices and architectural/interior design features can be used to make a home usable for disabled people. It then presents a study of consumer acceptance of such devices and design features. Finally, recommendations are presented for an approach to the design of dwellings that recognizes the needs and desires of disabled people.

Table 1 presents a list of independent living activities and associated means to support people with disabilities in performing those activities by both design features and adaptive devices. For some activities, the two approaches compliment each other. In others, a design feature or adaptive device solve the same problem.

Rehabilitation specialists and consumers themselves have utilized everyday products in imaginative ways. The suction cup or clothespin, for instance, provides a means of stabilizing dishes or tools for people with hand limitations. Convenience products such as prepared foods or non-stick cookware or new, small appliances like table-top ovens and electric knives become affordable and desirable alternatives to once strenuous tasks or extensive environmental adaptation. Recently, products designed for military and space programs, such as teleoperators, have been adapted to augment human movement limitations and, thereby, increase the probabilities of independence for severely disabled people (Journal of American Geriatrics Society, July, 1969, p 842). Architects, interior designers and product designers have developed a variety of cabinet details, special plumbing fixtures, grab bars and other design features that can be installed in a dwelling to improve its usability for disabled people. Examples of both devices and design features are shown in Figs. 1-5. It should be noted that the figures are illustrative only and are not meant as recommendations.

Some design features and adaptive devices, however, may prove cumbersome, inappropriate or unreliable when used under the extensive variety of conditions in the physical environment. In particular, a device may be obnoxious and a source of stigma to the user because of its appearance or connotations. Anxiety toward specific tasks or social situations, along with adverse emotional effects, can cause physiological changes, actually increasing the energy output necessary on the part of the individual for task completion (Rusk, et al., 1967).

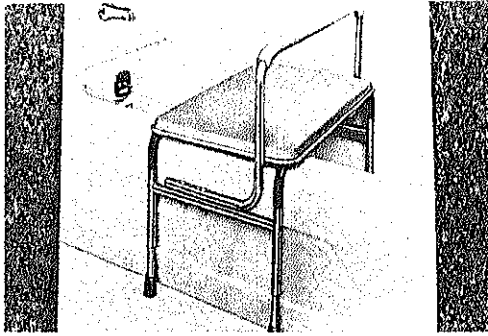
The cost of accessibility is always a problem. Adaptive devices are often much less expensive than permanent design features. Moreover, in rental housing, a full range of adaptations must be made to a dwelling even if all of them are not needed for each individual tenant. Whereas, adaptive devices can be supplied only when necessary. Finally, adaptive devices are portable -- they can be moved with a person while design features must remain in a dwelling.

Faced with all the possible ways to support independent living by disabled people, the planner and designer must determine the most appropriate strategy. The criteria for selecting a strategy should not be limited to cost alone because money spent poorly can be worse than not spending any money at all. We can determine the spatial requirements for accessibility through human factors research (see for example, Steinfeld, et al., 1978). However, broad design issues concerning what kind of accommodations we can expect consumers to make on their own through the use of adaptive devices and what a dwelling unit should look like, can best be answered by consumers themselves.

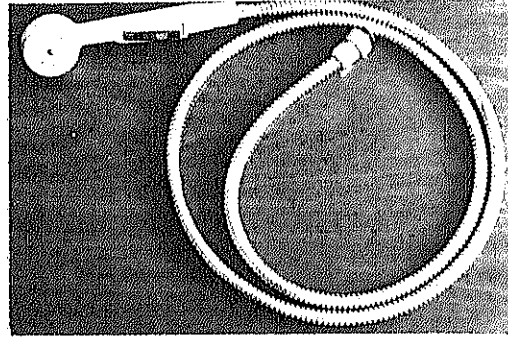
Table 1: Methods of Support for Activities of Daily Living

Activity	Architecture/Interior Design	Adaptive Devices & Equipment
<u>Cleaning Activities</u>		
Wipe up spills from counter	Counter heights, depths, material, color, gutter	Sponge, reachers, glove/sponge mitt
Pick up objects from floor		Reachers, sit in chair, use "step" chair
Make bed	Furniture design, clear space around bed	Elevate/lower bed, casters, method, human assistance
Dusting high surfaces	Low shelving, air purifiers	Reachers, vacuum attachment, broom, mop
Mop kitchen floor	Surface material, color selection	Mop
Carry cleaning tools	Multiple storage areas, centralized vacuum	Cart, basket, lap board
Clean bathtub	Faucet control location, hose spray, height of ledge	Mop, toilet brush, reachers, spray
Carry pail of water	Multiple faucets	Hose, cart, lap board
<u>Meal Preparation</u>		
Turn on water	Water mixing valve, location, identification	Built-up handle, lever handles, reachers
Turn on stove	Front controls, redesign cueing, arrangement, front access	Built-up controls, tape markings, portable cook top
Cut vegetables	Adjustable open-front work station, ledges	Spike cutting board, french knife
Carry pan with water	Hose spray, proximity of functions, level counter	Lap board, cart
Remove items from refrigerator	Pull-out rest board, proximity of functions	Cart
Reach to base cabinets	Storage in easily reached racks and shelves	Counter top racks, multi-use cookware
Carry pan to oven	Level counters, proximity to preparation and storage areas	Oven shovel, lap board
Use oven	Door swing, window shelves, height	Mitt with grip surfaces
<u>Laundry</u>		
Operate automatic washing machine	Front loading machine, front controls, control type	Built-up controls, adjustable height of washer
Hang wet clothes	Dryer service	Dryer, pulley clothesline, reachers, cart
Transfer clothes from machine	Rest area, machines adjacent on same plane	Cart, table, basket
<u>Personal Hygiene</u>		
Combing hair	Tilt mirror, lighting, mirror height, vanity height	Hand/neck held mirror, built-up handles, assistance
Washing extremities	Shower, no threshold, seat	Hose spray, sponge on extension, assistance
Washing face	Open sink front, sink height, faucet control type and location	Sponge glove/mitt
Using shower	Grab bars, no threshold, door width, area, controls, seat	Hose spray, use bath, assistance
Getting into bathtub	Grab bars, seat, faucet control/location, ledge height	Bathmat, bath seat, transfer board
Getting onto toilet	Space at sides and front, seat height, grab bars, trapeze	Built-up seat, seat with grab bars, commode seat, bedpan
Washing hair	Sink height, open front design, contour sink	Hose spray, rinse tray
<u>Mobility Problems</u>		
Enter apartment lobby from street	Ramp, curb cuts, railings, automatic doors, hardware, etc.	
Entering and operating elevator	Door width, control panel height, type, railings	Mouth stick, extender, pointer
Climbing curbs or steps	Ramp, grade, railings	Cane block, walking aid

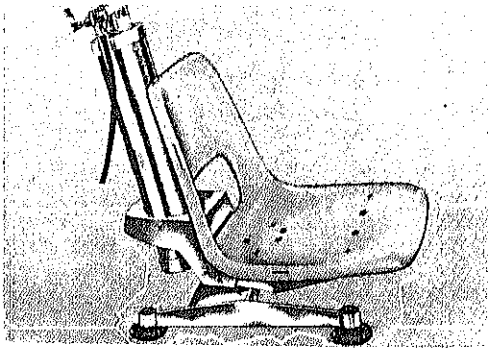
Figure 1: Bathing Aids



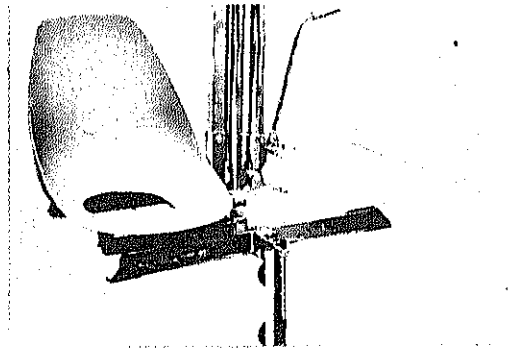
Bathtub Seat



Hand-held Shower



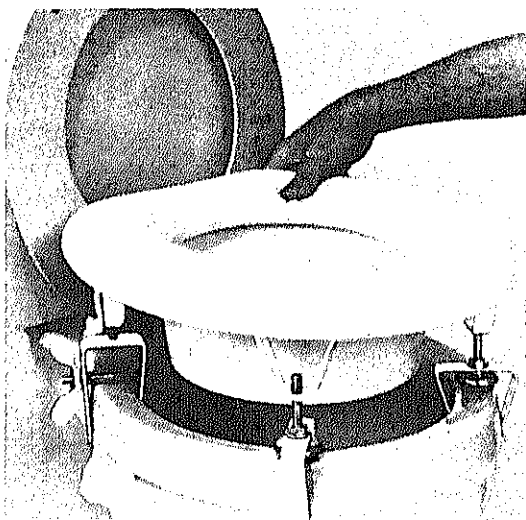
Bathtub Seat



Bathtub Seat

A variety of bathtub lifts and seats allow for access to the bathtub at a level close to the height of the wheelchair seat or standard chair seat. Bathtub lifts raise and lower so that the user can be partially submerged in water. Hand-held showers can now be purchased with a variety of features and many styles. Some connect to existing shower fixtures.

Figure 2: Toileting Aids



Elevated Seat



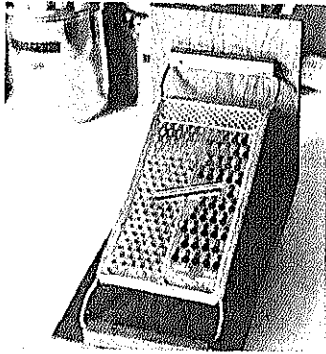
Wash n' Dry Seat



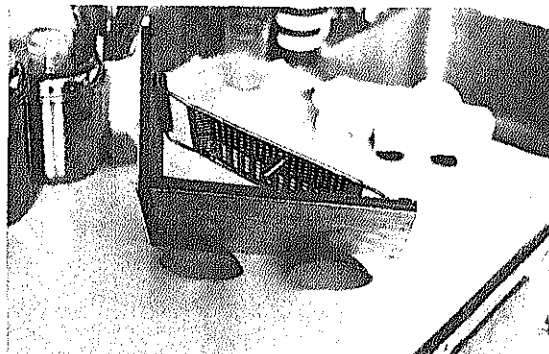
Commode

An increase in seat height provides for greater ease of transfer by the wheelchair user as well as less strain in setting down or getting up by the ambulatory or semi-ambulatory individual. The wash n' dry toilet seat is a definite hygiene aid, especially for those with limited use of their upper extremities.

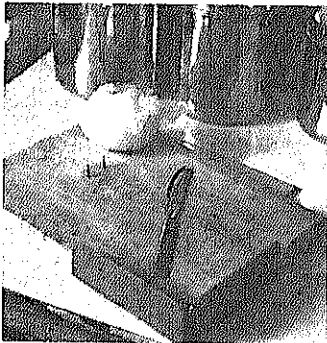
Figure 3: Home Use Aids



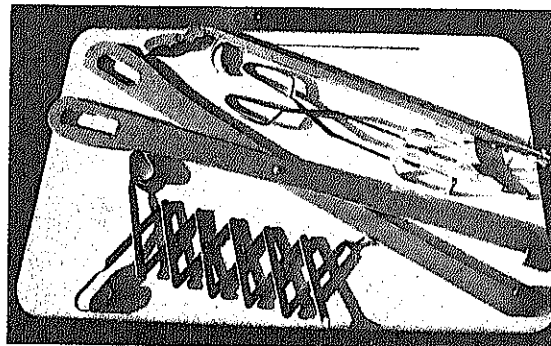
Shredder



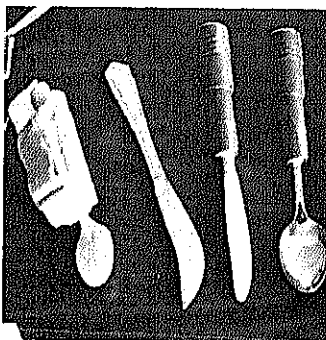
Shredder



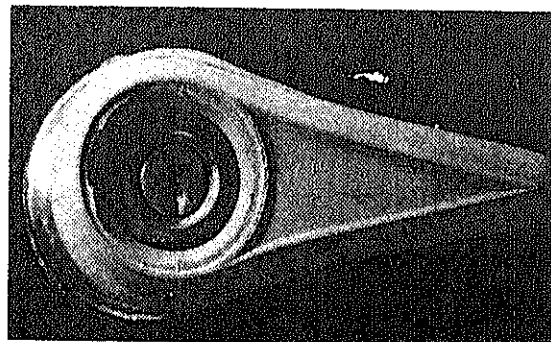
Spiked Cutting Board



Reachers



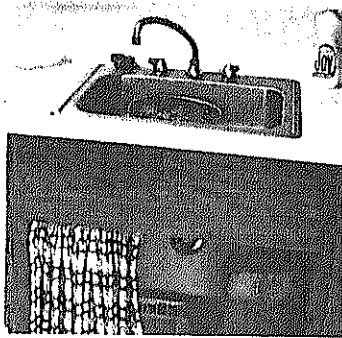
t-up Handles



Door Knob Extensions

are available to help in meal preparation and general house-
cutting boards and suction cups on shredders allow one-
on. Reachers are often useful to many people. Implements
o handles are helpful for people with limitations in use of
knob adapters provides an easier grasp and leverage.

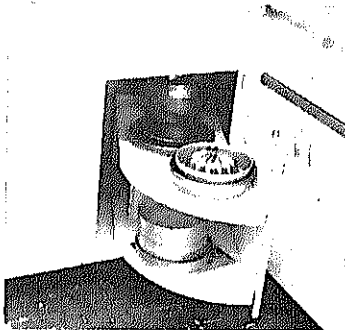
Figure 4: Special Cabinetry



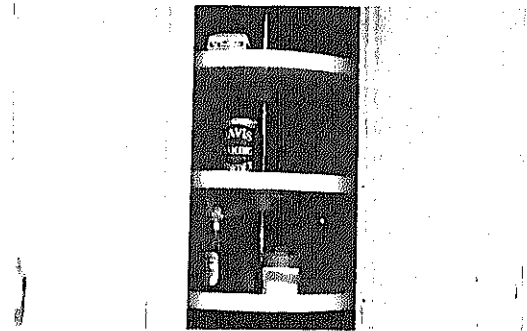
Space Under Sink Counter



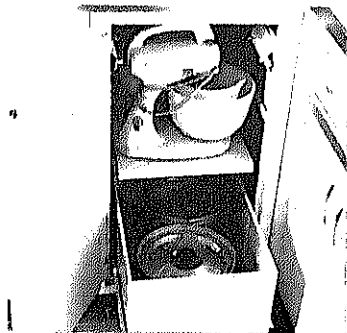
Sliding Glass Cabinet Doors



Shelves on Doors



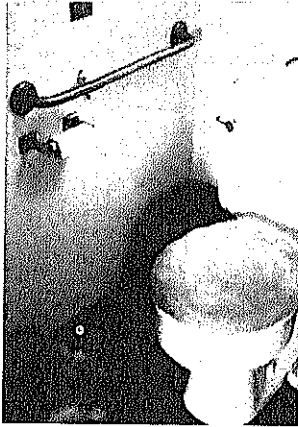
Lazy Susan



Slide-Out Shelves

Sliding doors and open cabinets allow areas. Open spaces under counters at the work center. Lazy susans in corner space and more convenience in use. Slide-out shelves reduce the need for bending and provide additional work space at below

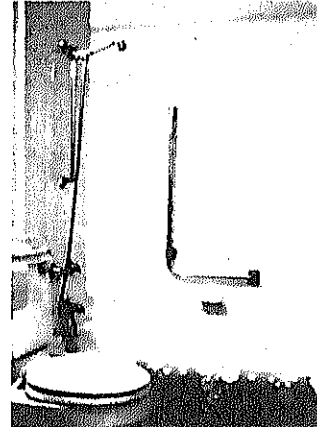
Figure 5: Supports



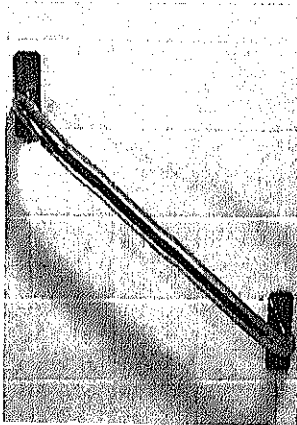
Horizontal



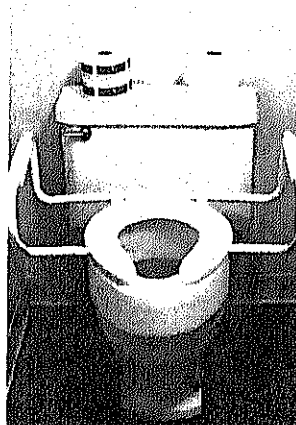
Mounted on Back Wall



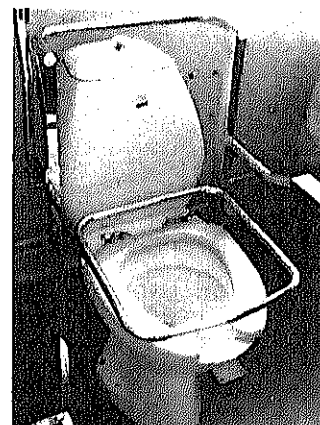
L-Shape



Diagonal



Toilet Mounted



Floor Mounted/Pivoting

Grab bars of various kinds provide support for transfers and changing positions. Some can be mounted on a toilet seat or on the floor.

Research Objectives

This research sought to answer the following questions:

1. Do people with disabilities view some devices and design features as stigmatizing?
2. Which ones are viewed more positively than others?
3. How do able-bodied people view such adaptations?

One way to answer these questions is to find out what kinds of adaptations people have made on their own. This would identify the type of adaptations consumers think are necessary and fall within the realm of acceptance. However, circumstances may force people to use items they really dislike. Another approach is to ask people what devices and equipment they think are useful and appropriate.

As part of a human factors study of accessibility, 200 disabled and able-bodied people were brought to our laboratory in a Syracuse University building for a series of research tasks. While at the laboratory, they were interviewed to obtain biographical data and to determine their use and opinions of adaptive devices, equipment and architecture/interior design features. In the development of the interview questionnaire, home visits were made to test the validity of questions. These home visits provided an opportunity to observe actual adaptations people had made by themselves.

Subjects and Procedure

The total sample of subjects numbered 200. Sixty-two people in the sample used wheelchairs; 126 had many other types of disabilities, including reliance on walking aids, low stamina and difficulty reaching; 12 people had no functional disabilities. The subjects were recruited from organizations of the physically handicapped and elderly and through public media and newsletter announcements.

A full description of subject recruitment, diagnosis of disability, distribution of subjects in disability categories and the laboratory setting can be found in another report (Steinfeld, et al., 1978). All the subjects, except for two, lived in independent housing units. Twenty subjects received home visits by our staff.

Tables 2 through 4 give a description of the respondents with respect to age, sex and residence. The data indicates that, as a group, the subjects lived mostly in private homes and were mostly women. Compared to the US population in general, they were an older group. The sample included more middle-aged and elderly people than does the US adult population (US Census, 1970).

The interview questionnaire took from 30 to 60 minutes to complete and was administered by trained staff. Its accuracy and usability had been pre-tested during three series of home visits to a total of 20 subjects.

The laboratory testing and interview actually was an enjoyable experience for most respondents since many of them left their homes only on rare occasions. Photographs of adaptive devices, equipment and architectural/design features were presented along with the questions so that there could be no misunderstanding about specific items being discussed. Subjects were paid for their participation and transportation was provided to and from the laboratory.

Findings reported here include only biographic data and the responses to the use and opinion of adaptive devices and equipment in kitchens and bathrooms.

Findings from Home Visits - Adaptations Observed

In kitchens, we found that the height of counter tops was always too high for wheelchair users. To compensate, it was common to see TV trays used for meal preparation since they were a more comfortable height. The kitchen table was used for this purpose too; some people used a small typing table on casters which could be locked in place for mixing and meal preparation and, when unlocked, could be used to transport food or dishes. Similarly, we saw utility carts (two and three shelf varieties) used for meal preparation and transporting items. Sometimes these tables and carts were used for dining in place of a table. Some people used a high kitchen chair or stool to make working at the counter top more comfortable. One individual, who had use of only one arm, used a TV table to hold the refrigerator door open while removing or putting food away.

Often we found that additional cabinet tops or even tops of washing machines or dryers, in the larger kitchens, were used to compensate for lack of counter space. Because some stoves and ovens are difficult to use from a wheelchair, some people preferred counter microwave ovens and electric fry pans which could be placed at more convenient locations. Peg boards were used to bring pots, pans and cooking utensils to a more reasonable level for storage. In one instance, an individual had upper cabinets in her rental apartment removed from the wall and placed on the counters within reach.

The other room where we often saw adaptations was the bathroom. We observed that shower stalls and bathtubs were used as a place for drying clothes and sometimes for washing large items. Showers were occasionally found being used as storage areas since occupants couldn't transfer into the shower. In place of manufactured shower seats or bathtub seats, some individuals used folding chairs or even lawn chairs in the bathtub.

Findings from Interviews - Use and Opinions

Table 5 displays the results of the survey for kitchen devices. The data on use show that only the single lever faucet was used by more than 23 percent of the sample. The data on sub-samples show that "other disabled" subjects were more likely to use items number 4, 6, 7, 10, 18 and 21. Able-bodied subjects were more likely to use items number 3, 16

Table 2: Age Range of Subjects Compared to U.S. Population (1970 Census)

Age	Distribution Range of Subjects	Age Distribution of Subjects by Percentage	Age Distribution of US Population by Percentage
Under 20	2	1.0	37.9
20-29	16	8.2	14.5
30-39	26	13.3	11.1
40-49	32	16.4	11.8
50-59	46	23.6	10.4
60-69	40	20.5	7.7
70-79	27	13.8	4.6
80 and Above	<u>6</u>	<u>3.1</u>	<u>1.9</u>
Total	195 ^a	100.0	99.9

^aThere were six diagnostic interviews missing, thus incomplete data available on age.

Table 3: Sex of Subjects

	Number	Percent
Male	60	30.3
Female	<u>140</u>	<u>69.9</u>
Total	201	99.9

Table 4: Residence of Subjects

Type	Number	Percent
Publicly Subsidized Housing ^a	37	18.3
Private	161	80.1
Home for the Aged	1	.5
Nursing Home	1	.5
Other	1	.5

and 17. Wheelchair users were more likely to use all other items. The low level of the overall use, and small differences, do not allow drawing any conclusions from this data.

The data for population show that a majority of the sample thought all the devices were good ideas, except the following: step stools (item no. 3), cabinets without doors (item no. 8), glass doors on cabinets (item no. 9), sinks with open spaces underneath (item no. 12), lap boards (item no. 15) and built-up handles on utensils (item no. 21). Of these items, all but number 8 and 9 were rated good ideas by over 40 percent of the sample, indicating that their unpopularity was not very great in an absolute sense, although, in comparison to the other items, it was much lower.

These items also received relatively high ratings as bad ideas which indicates a definite strong negative feeling about them. Subjects commented that cabinets without doors and cabinets with glass doors would be useful but they preferred not to have the contents of cabinet shelves visible.

The data shows that respondents thought that the mix counter with an open space underneath (item no. 13) was a much better idea than the sink with an open space. But these two items were viewed much more positively by wheelchair users than able-bodied people and other disabled people. These findings may have two explanations: 1) ambulant subjects did not like the idea that pipes would be visible or 2) ambulant people did not wish to sit down while washing dishes.

An explanation of the low opinion of step stools, lap boards and built-up handles lies in indifference and differences between sub-samples. Respondents who had no need for these items may simply have had no opinion. The response to lap boards and built-up handles, in fact, shows that about 10 and 8 percent, respectively, of the respondents had no opinion or did not answer these questions. For the step stool item, the no opinion or no response tally was only about 5 percent. The responses to the step stool item shows that the inability to use step stools resulted in a very low rating among wheelchair users, although they were rated very highly by able-bodied and other disabled people. Lap boards may have been perceived as items identified with wheelchair use and built-up handles with severe incoordination. Both these items received large negative ratings from the sub-samples who would have no need for them, and high positive ratings from the sub-samples that would have a need for them.

Reviewing the items that were very popular (above 80 percent, good idea), e.g. items number 4, 5, 6, 7, 14 and 18, one can see that these were items that would make use of a kitchen more convenient to any person. In fact, all of these items received consistently high ratings from all sub-samples. They were all built-in, architectural/interior design items. They were also basically invisible when not in use.

Table 5: Use and Opinion Toward Adaptability Features in Kitchens in Percentages (A = able-bodied subjects, W = wheelchair users, OD = other disabled, T = total sample)

	Uses It				Does Not Use It				Good Idea				Bad Idea			
	A	W	OD	T	A	W	OD	T	A	W	OD	T	A	W	OD	T
1. Extenders, reachers for low shelves	0.0	22.6	7.1	11.5	91.7	74.2	89.7	85.0	41.7	74.2	71.4	70.5	3.0	21.0	23.8	24.5
2. Extenders, reachers for high shelves	0.0	21.0	6.3	10.5	91.7	74.1	91.3	86.0	41.7	62.9	73.8	68.5	50.0	30.6	23.0	27.0
3. Step stool of special chair	41.6	8.0	38.8	29.5	50.0	85.5	58.8	66.5	75.0	11.3	60.3	46.0	16.6	79.0	37.3	49.0
4. Lazy susan for upper cabinets	8.3	16.1	19.0	17.5	83.3	79.0	79.3	79.5	66.6	70.9	88.0	85.0	16.7	24.2	9.5	14.5
5. Modified lazy susan for lower corner	8.3	8.1	6.3	7.0	83.3	88.7	92.0	90.0	83.3	83.9	80.4	88.0	8.3	11.3	7.1	8.5
6. Pull out shelf	0.0	1.6	7.9	4.5	91.6	95.2	90.5	92.0	75.0	87.1	86.5	86.0	8.3	8.1	11.1	10.0
7. Pull out drawer at bottom of lower cabinet	8.3	11.3	13.5	12.5	83.3	85.5	85.0	85.0	83.3	85.5	81.8	83.0	8.3	11.3	16.7	14.5
8. Cabinets without doors	0.0	4.8	4.8	4.5	91.7	91.9	93.7	93.0	16.7	24.2	13.5	17.0	66.7	67.7	83.4	77.5
9. Glass doors on cabinets	0.0	1.6	1.6	1.0	91.7	93.1	96.0	95.5	16.7	29.0	32.5	30.5	75.0	64.5	59.5	62.0
10. Sliding doors on cabinets	0.0	3.2	4.0	3.5	91.7	88.7	94.5	94.0	66.7	74.2	73.8	73.5	25.0	16.1	19.9	19.0
11. Counter top storage racks	16.7	25.8	14.3	18.0	75.0	70.9	83.4	79.0	58.4	67.7	63.5	64.5	33.3	27.4	29.4	29.0
12. Sink with open space below	8.3	16.1	11.1	12.5	83.3	80.6	87.3	84.0	41.6	77.4	34.9	48.5	50.0	19.3	63.5	49.0
13. Mix counter with open space below	8.3	6.5	4.8	5.5	83.3	90.3	93.7	92.0	66.6	83.9	57.2	66.0	25.0	11.3	41.3	31.0
14. Pull out board	16.7	9.7	7.1	8.5	75.0	87.1	91.3	89.0	83.4	87.1	79.3	82.0	8.3	8.1	17.5	14.0
15. Lap board	8.3	22.6	6.4	11.5	75.0	74.2	86.6	82.0	41.6	61.3	31.8	41.5	41.7	32.3	56.4	48.0
16. Spiked cutting board	16.7	4.8	7.9	7.5	75.0	91.6	89.7	89.5	66.7	70.9	68.2	69.0	25.0	22.6	26.2	25.0
17. Vegetable shredder with suction cups	8.3	1.6	2.4	2.5	75.0	90.3	94.4	94.0	58.3	79.0	73.8	74.5	16.7	12.9	22.2	19.0
18. Special lighting on work surface	16.7	17.7	26.2	23.3	75.0	79.0	72.2	74.5	75.0	85.4	92.1	89.0	16.7	8.1	6.3	7.5
19. Countertop oven	8.3	29.0	21.4	23.0	83.3	67.7	77.0	74.5	58.3	77.4	72.2	73.0	25.0	17.7	20.6	20.0
20. Sink with single lever faucet	33.3	43.5	40.5	41.0	50.3	53.2	55.6	55.0	66.6	75.8	75.4	75.0	25.0	17.7	10.3	18.5
21. Built-up handles on utensils	0.0	4.8	7.1	6.0	91.6	91.9	91.2	91.5	33.3	43.5	51.5	48.0	58.3	50.0	39.7	44.0
22. Cooking utensils on a peg board	16.7	20.9	19.1	19.5	75.0	75.8	79.4	77.0	58.4	59.6	73.1	68.0	33.3	33.9	23.0	27.0

Sample Size: A = 12, W = 62, OD = 126, T = 200

Note: None of the No Answer figures were used in this table.

Another set of items was less popular, e.g. items number 1, 2, 10, 11, 13, 16, 17, 19, 20 and 22. Although items 10 and 20 are architectural/interior design features, the rest are devices and equipment, e.g. extenders or vegetable shredders. It is interesting that some of these items, which were developed as part of occupational therapy for specific disabilities, have a fairly widespread acceptance among the entire sample, which included people with many types of disabilities. For example, vegetable shredders with suction cups and spiked cutting boards have been developed specifically for people who can only use one arm to do certain tasks but they both were considered good ideas by all three sub-samples. In fact, the use of these two items was highest among the able-bodied group.

The difference in popularity for this second set of items compared to the very popular items may be due to the perception that many of the equipment items are specifically for people with disabilities or simply are visibly different. They may have some stigma associated with them because of this. Some items in this second set are commonly used by all people, e.g. single lever faucets and peg boards, and are thus familiar items. Others, such as reachers, spiked cutting boards and vegetable shredders are modifications of familiar kitchen or industrial equipment and may be viewed as improvements. This could explain why these items were rated more positively than the unpopular items.

A separate set of questions explored opinions about electrical and plumbing controls. The majority of respondents had handles on their kitchen cabinet doors and they also preferred handles over knobs and other openers when asked their preference. The type of faucet controls for the kitchen sink were evenly divided between the lever handles and the single lever. However, when given a preference for ease in use, the majority (60 percent) preferred the single lever type. Seventy percent of the respondents had burner controls at the front of their stove at home; 65.5 percent preferred that location. There were frequent negative comments about push-button stove burner controls located in the front of the stove. Respondents felt that these were easily turned on by accident when someone leaned against them.

Table 6 displays the findings for bathroom items. The data for use indicates that grab bars are used more than other items. Wheelchair users used grab bars more often at toilets than at other fixtures, but the data for bathtubs and showers are confounded by the fact that some people only had showers and others only bathtubs. None of the items were as popular as the very popular group of kitchen devices (over 80 percent, good idea). The commode seat and bed pan were particularly unpopular, indicating that only a few of the sample wished to rely on such items.

Table 6: Use and Opinion Toward Adaptability Features in Bathrooms in Percentages (A=abled-bodied subjects, W=wheelchair users, OD=other disabled, T=total sample)

	Uses It				Does Not Use It				Good Idea				Bad Idea			
	A	W	OD	T	A	W	OD	T	A	W	OD	T	A	W	OD	T
Elevated toilet seat	25.0	22.6	7.1	13.0	66.6	75.8	91.3	85.0	25.0	54.9	51.6	51.0	66.9	43.5	46.8	47.0
Commode seat	8.3	14.5	4.8	8.0	83.4	85.4	93.7	90.5	25.0	32.2	25.5	27.5	66.7	67.7	73.0	71.0
Bed pan	0.0	17.7	2.4	7.0	91.7	79.1	95.2	90.0	0.0	27.4	19.1	20.5	91.7	69.4	78.5	76.5
Grab bars for getting onto/off toilet	16.7	40.3	21.4	27.0	75.0	58.0	77.8	71.5	50.0	64.5	73.0	69.0	41.7	33.8	26.2	29.9
Grab bars for getting in/out of bathtub	16.7	8.1	28.6	21.5	75.0	82.2	70.7	76.5	58.4	43.5	83.4	69.5	33.3	53.2	15.9	28.5
	16.1	16.1	26.0	23.0	66.7	82.2	70.6	74.0	66.7	54.8	79.3	71.0	25.0	43.5	17.5	26.0

n = 200

the knowledge that not all the subjects had a bathtub and not all had a shower.

One might expect higher percentages than those shown in the table in favor of grab bars. However, when the subjects were asked about grab bars, we sometimes heard comments such as, "They're not a good idea for me; I don't need them. They are for the crippled or handicapped." Likewise, in the actual testing, some of the subjects were careful not to use any of the grab bars to prove that they didn't need them. There were 40.5 percent who said that they used some other device as an assist in getting on and off the toilet--the sink was the object most often used.

Respondents were also asked what aids they used most often for washing their hair, i.e. hose spray, rinse spray or someone's assistance. The greatest percentage of response, 30 percent, was "no special aids", followed by "someone's assistance", at 23.5 percent (often a hairdresser). When asked if some other device was used, four percent said they used a cup.

Lever handles with separate handles for hot and cold were the most often used type of bathroom faucet control. Lever handles with separate hot and cold handles and single lever faucets were both preferred equally over knobs and dials.

When the subjects were asked if they preferred taking a sponge bath, taking a shower or taking a bath, the response was almost evenly divided between taking a shower (48 percent) and taking a bath (48.5 percent). This is an indication that multi-family housing should have some accessible units with bathtubs and some with showers. Only 40.5 percent of the respondents had a chair or some type of seat in or near the bathtub or shower, but 69 percent felt that it was a good idea (50 percent of the able-bodied group).

Only 15 percent of the consumer testers said that they used a hand-held shower and 53 percent felt that it would be a good idea. A majority of those who said that a hand-held shower was not a good idea felt that it was inconvenient. These people may have thought that the hand-held shower would be used as a substitute for a fixed shower spray. Twenty-percent of the sample used their bathtub or shower for something other than bathing or washing clothes--usually this was drying clothes. Washed clothing in their bathtub or

the able-bodied group. This contrasts with the elevated toilet seat which was not popular with the able-bodied group.

Research Conclusions and Policy Implications

Summarizing the results of the home visits and opinion survey, the following broad conclusions can be made.

1. There is definitely a dislike for some adaptive devices and architectural features.
2. Some architectural features are received very well, particularly those items built into kitchen cabinetry that are invisible when not in use.
3. Some adaptive equipment items are popular, even to those for whom they are not specifically intended.
4. People readily develop adaptations of dwelling units on their own, usually by building convenience equipment or using something in a different way than as intended.

Specifically, the findings suggest that from a consumer acceptance point of view, accessible kitchens and bathrooms should be designed to be convenient for use but not different in appearance than conventional kitchens and bathrooms. Particularly:

1. Open cabinets and glass cabinet doors should be avoided in kitchens.
2. Spaces under kitchen sinks should not be provided until they are needed.
3. Grab bars should not be installed in bathrooms unless they are needed.
4. Provisions in bathrooms should go as far as possible to avoid the necessity of using bed pans chairs.

principles is the promotion of the concept of adaptability:

1. Counter work centers should be conventional in appearance allowing adaptation to provide space under counters when required.
2. Cabinets should be conventional in appearance but convenient to use.
3. Reinforced areas in walls should be provided for installation of grab bars, but grab bars should not be provided until required.
4. Hardware should be conventional in appearance, but convenient to use.
5. Work simplification features should be invisible, such as pull-out boards and lazy susans in cabinets.

Finally, the availability of task simplification equipment, on the general consumer market, in the form of new designs of existing products such as cutting boards or shredders, raised toilet seats, shower seats or new products should be based on familiar models. The home visits demonstrated that such equipment would be purchased to make housework and personal hygiene tasks easier.

This initial study of the consumer acceptance of adaptive devices and features also identified three areas of further investigation. Some items that are clearly identified with disability, e.g. grab bars, were rated more favorably than others, e.g. sinks with open spaces underneath or built-up handles. Moreover, other items were not clearly identified with disability, e.g. open or glass cabinets and were still not rated favorably. There are obviously many reasons why people disliked certain items. Further research should clarify the dynamics of such ratings and seek to determine the role played by stigma in the popularity of adaptive devices and architectural/interior design features in relation to other psycho-social variables. Also, the low level of use for most items makes one wonder whether familiarity might affect consumer acceptance. Finally, disabled subjects often viewed themselves as able-bodied. What role does self-concept play in determining one's acceptance of adaptive devices and features?

The major objectives for a policy on accessible housing should be: A) to provide enough housing to meet the need, and B) to allow sufficient diversity in available living arrangements for disabled people to have self-determination in their mode of living. Furthermore, a housing policy must acknowledge that disabled people are often part of family groupings as children or as parents and also are concerned about location, neighborhood quality, investment value and other considerations besides accessibility that play a role in choosing a place to live.

Specific policies for accessible housing cannot be developed in the abstract. The predominant type of housing in a community, the existing market, the amount and type of existing accessible units and other local factors must be considered before specific policy options can be evaluated for a community. However, the concept of "accessible" dwelling

units that is used may have a great bearing on the policy options that are considered because of marketing and cost considerations. For example, if an accessible dwelling unit is one that simply has doorways wide enough for passage by a person in a wheelchair and interior circulation spaces with enough maneuvering clearance, the cost of making all units in elevator-equipped buildings and at grade level accessible, would not be significantly different than conventional design. But, in addition, if grab bars are required in all places where they might be needed by people with various disabilities, and if special cabinetry in kitchens is required as well, the increased cost for accessible dwelling units would be over \$500/per unit. This cost difference could be significant enough to affect the marketability of accessible dwelling units, particularly in the private sector. Since one cannot expect that an accessible unit can be marketed at a higher price than a conventional unit, the increased cost of construction would have to be absorbed by the owner or builder, or to keep overall costs down, reductions would have to be made in the overall quality of dwelling units.

Reducing profits for speculative building or reducing overall housing quality is not a feasible way to encourage the construction of accessible dwelling units outside the public sector. If the major objectives delineated above are to be met, the private sector must provide accessible units.

Two important considerations in deciding on the best approach are the problem of reserved dwelling units and the consumer acceptance of accessibility by able-bodied people. Requiring a fixed percentage, say 2 to 5 percent, of rental dwellings to be fully equipped for disabled people would mean that such units would have to be held off the market until a disabled person rented one. This translates into a loss of income for owners. Moreover, how could one decide if those units should be efficiency units, one bedroom dwellings or larger? Requiring a fixed percentage of such units would result not only in cost increases or quality decreases, but also in a consumer reaction. The study described in the previous sections demonstrated that even disabled people are not particularly enthusiastic about visible adaptive design features. Given their attitude, it is unlikely that able-bodied people will view such features favorably. On the other hand, providing only very basic accessibility provisions, such as wider doorways and clearances would not support independent living for the severely disabled.

The rest of this report will describe the concept of adaptable dwellings, which, if applied in a reasonable and constructive way, would not only insure the possibility of independent living for severely disabled people, but also have minimal impact on cost, marketability and consumer acceptance. Use of this concept could allow large numbers of accessible units to be built, thus meeting the need, providing opportunities for disabled people to visit their neighbors and eliminating the necessity to reserve units for disabled people.

Recommendations: Adaptable Dwelling Units

1. Definition

Adaptable Dwelling Unit: Initially accessible to disabled people in terms of entry and circulation and adaptable, through minor renovations and additions to use as a residence by one or more severely disabled people.

Housing designed to be accessible to and usable by physically disabled people has typically been constructed with all the necessary equipment and design features already in place. As we have seen, this approach has serious limitations in both cost and marketability. A definition of accessible housing that is based upon the provision of adaptable dwelling units can overcome these limitations. An adaptable dwelling unit would have the features described below.

2. Circulation

Recommendation: At least one path of travel without stairs should be provided from the main entry of the unit to all rooms and spaces necessary for cooking, eating, sleeping, personal hygiene, storage, leisure and child rearing.

Discussion: Doors should be wide enough for passage by a person in a wheelchair. Maneuvering clearances at doorways and in halls should be large enough for a person to negotiate in a wheelchair. This means that an individual who uses a wheelchair could gain entry to all rooms and outdoor spaces necessary for the above activities, although other rooms may be provided to which they could not gain access. For example, the master bedroom and one bedroom for a child in a dwelling unit designed for families should be accessible, but additional bedrooms can be on a second story, reached only by stairs; a full bathroom should be accessible but a second bathroom may be provided that is also on the second floor. The clearances required can be provided by careful design without adding space to a conventional dwelling unit floor area (see Figs. 6-9).

sufficient space for maneuvering
in reach and alternate working

y designing conventional base
ix center and sink (see Figs. 10-11).
rovided underneath when the fronts
mounted at a height of 48 inches
he sink and mix center should be
f necessary (see Fig. 11). Rough-
be at a position that would ac-
nk. Clearances should be large
wheelchair. This means that the

clearances large enough to maneuver wheelchairs

door opens out and has at least 24 in space at latch side

24 in space at latch side of door

passageway at least 36 in wide

at least 40 in clearance between cabinets

passageways at least 36 in wide

24 in space at latch side of door

at least 36 in clearance around bed

all doors: 32 in clear opening, minimum

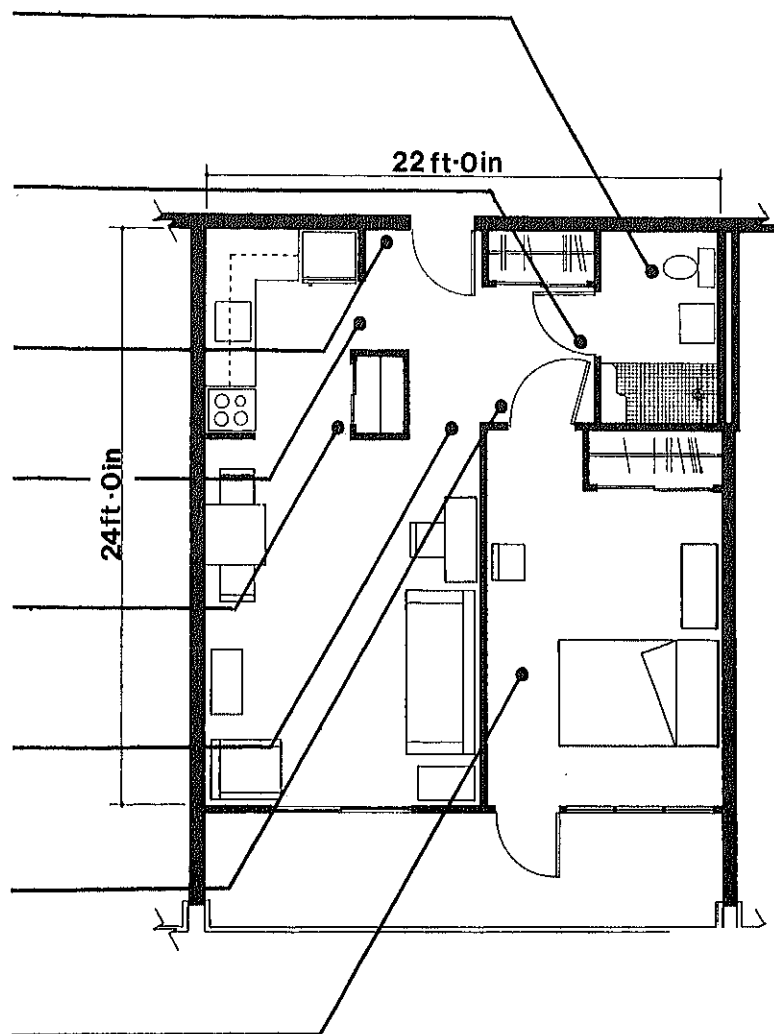


Figure 6: Single Bedroom Apartment

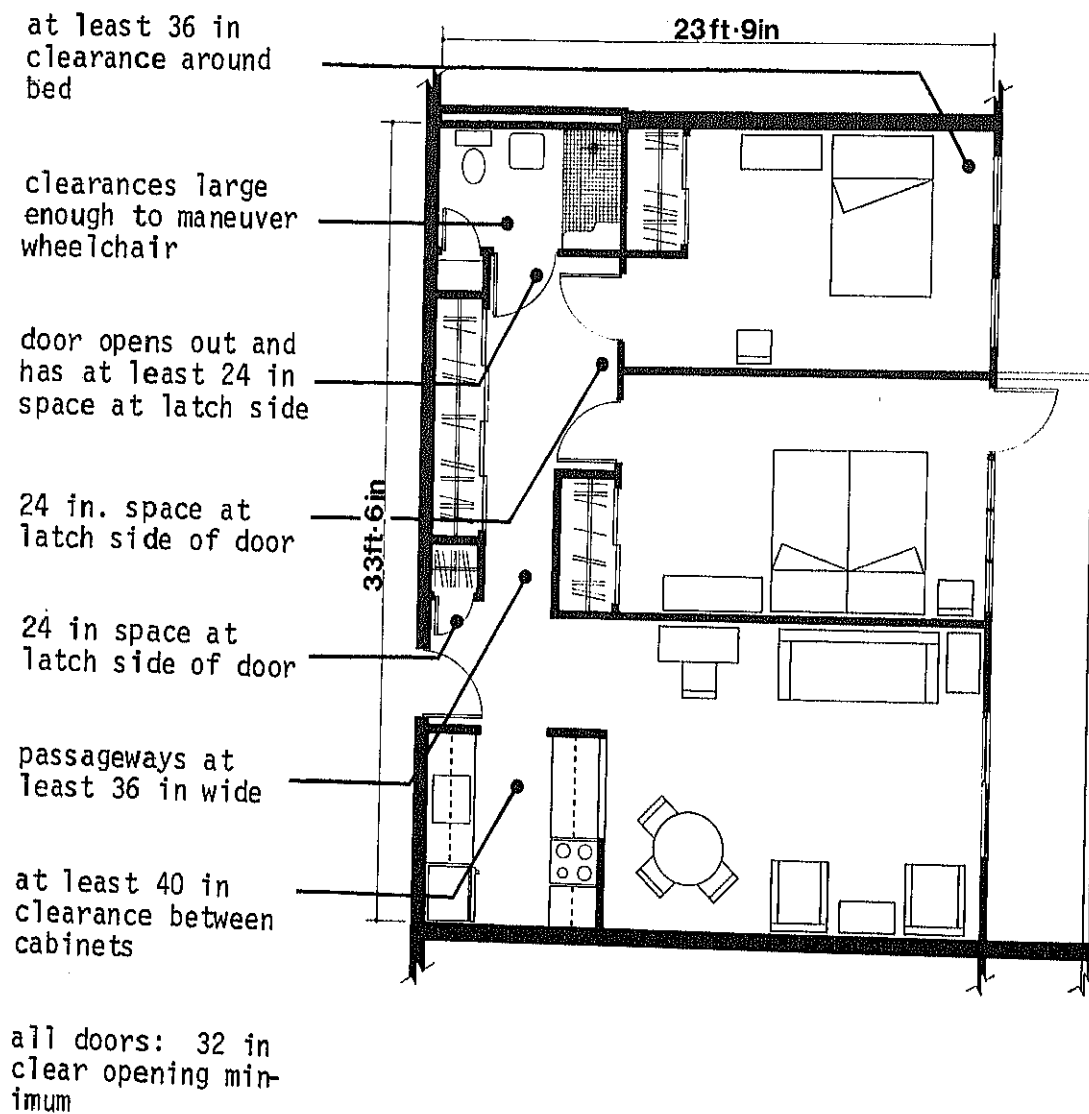
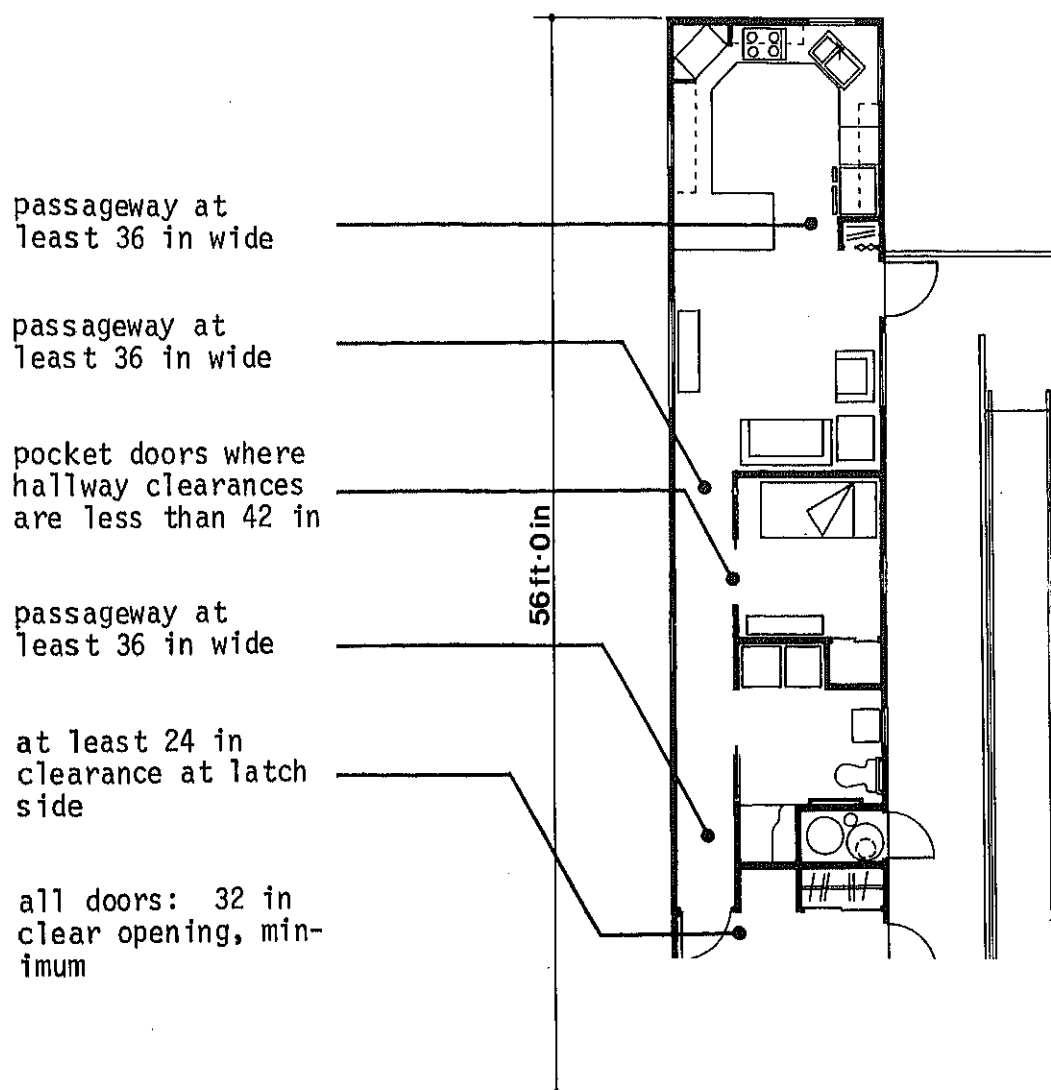


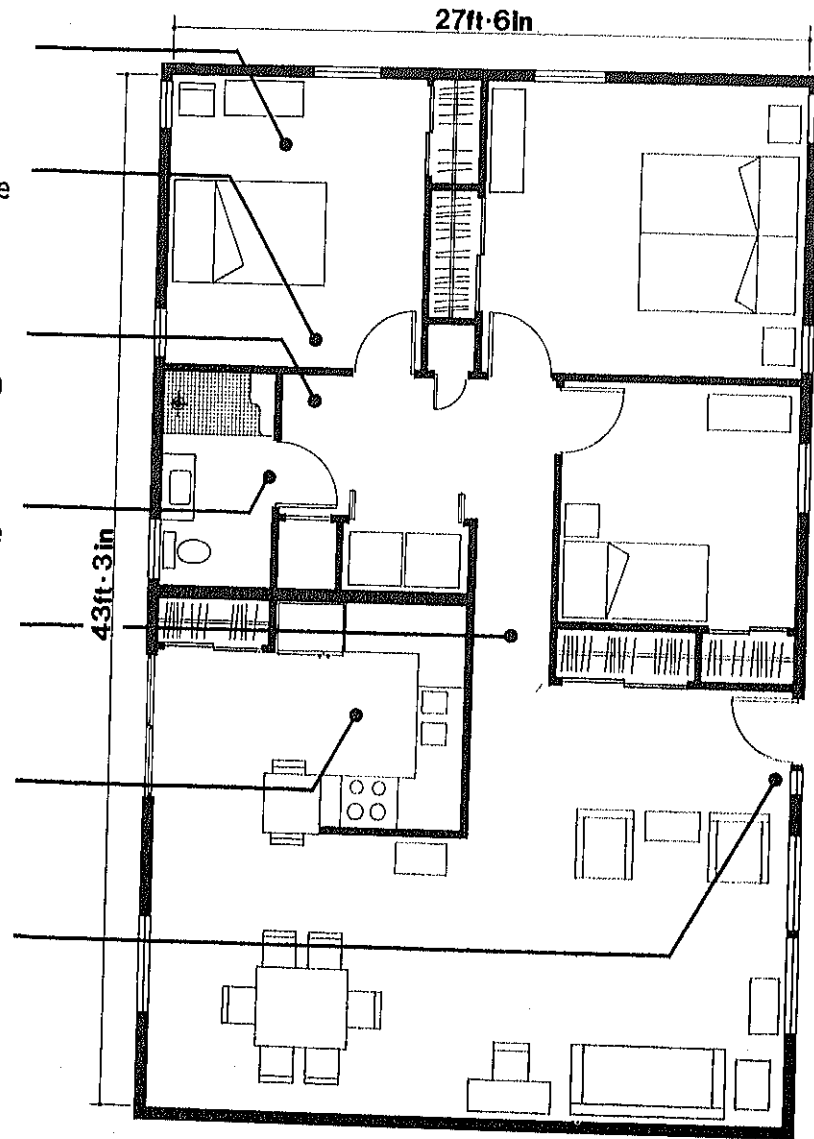
Figure 7: Two Bedroom Apartment



Note: Use of plan with permission of
Environments, Inc.

Figure 8: Mob

- at least 36 in
clear around bed
- at least 24 in
space at latch side
- at least 42 in
clear space in
hallway in front
of doors opening in
- door opens out and
has at least 24 in
clear at latch side
- passageway at least
36 in clear
- at least 60 in
clearance in U-
shaped kitchen
- at least 24 in
space at latch
side
- s: 32 in
aning, min-



y Home

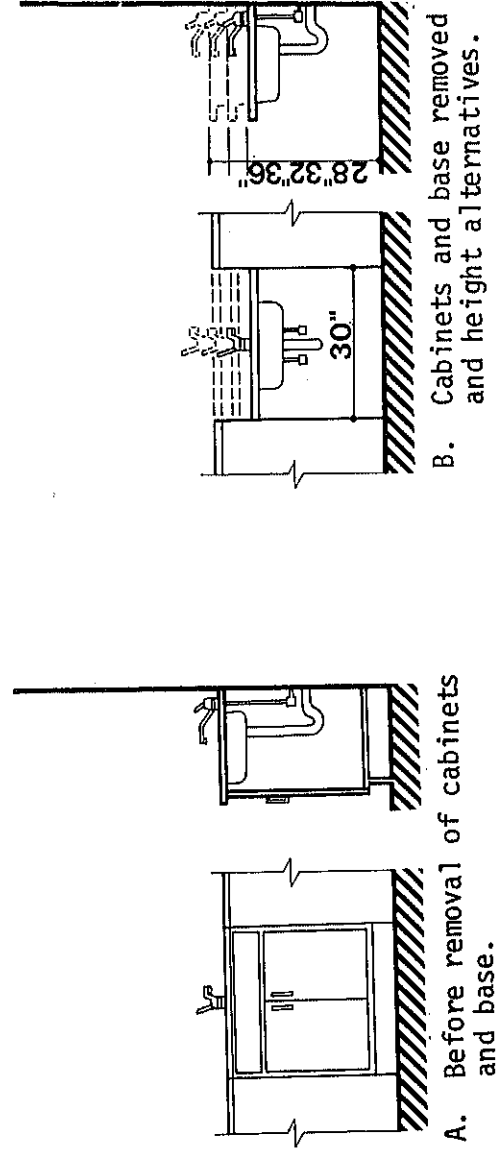
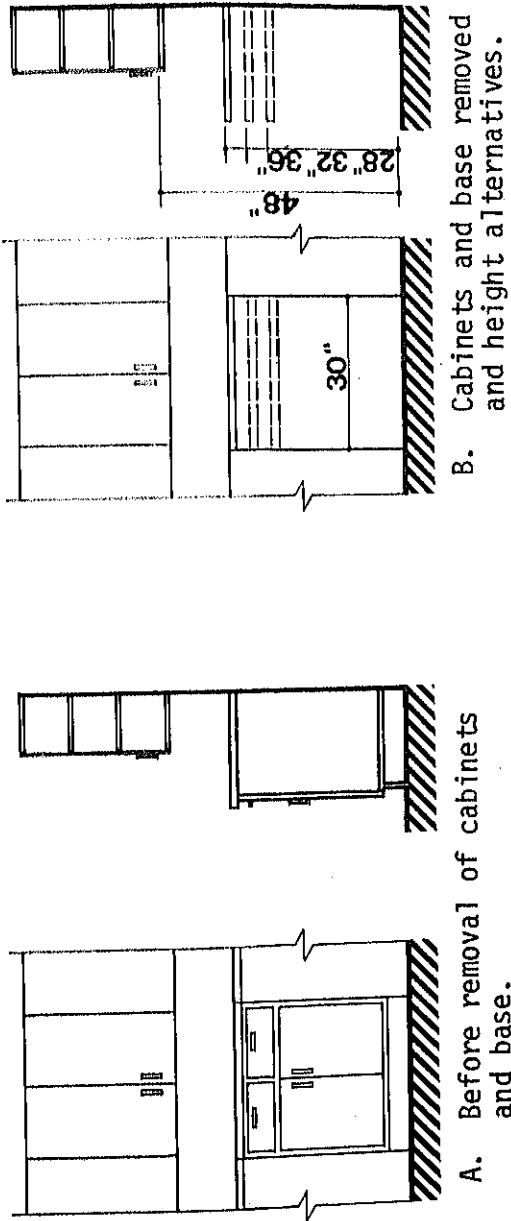


Figure 10: Adaptable Counters and Sinks

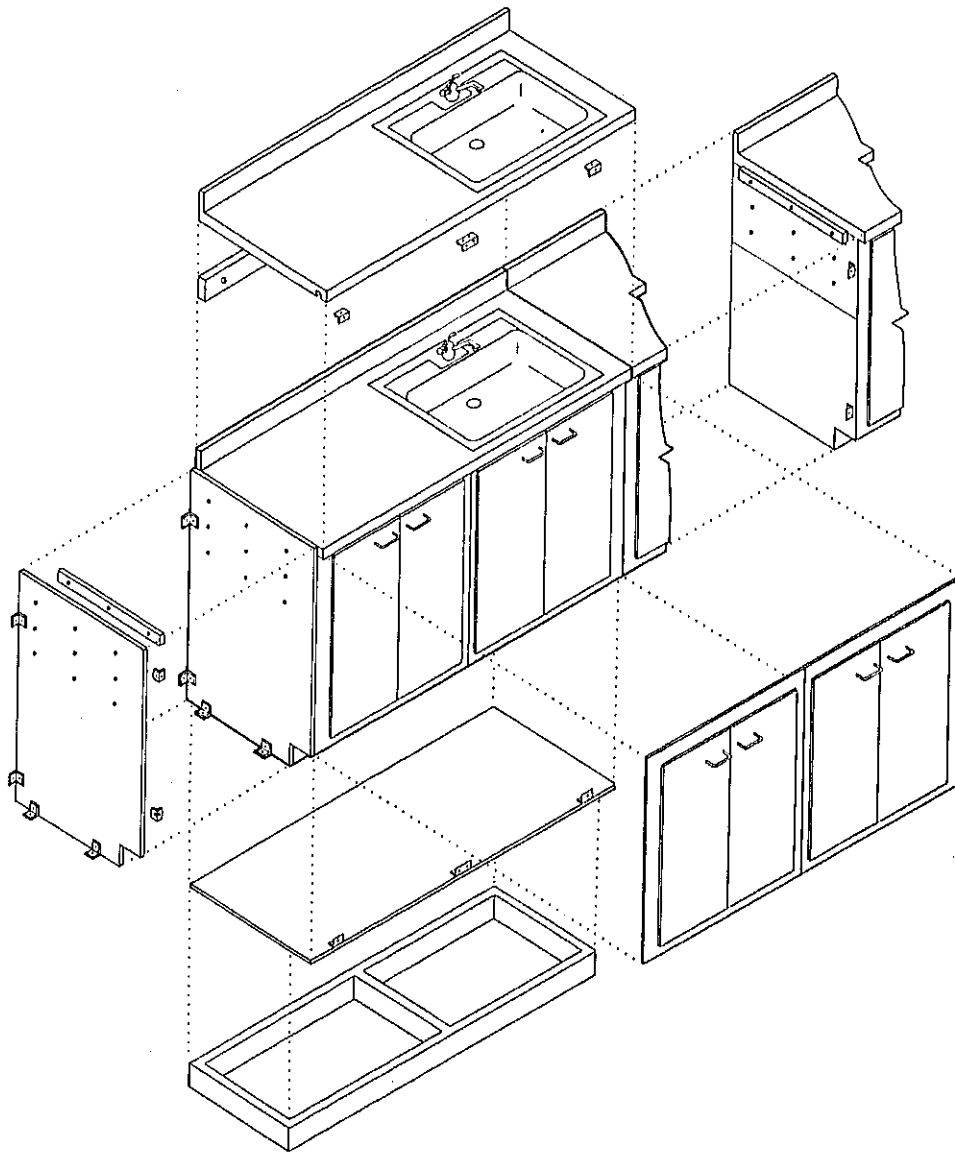
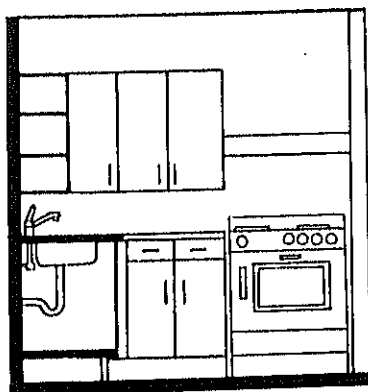
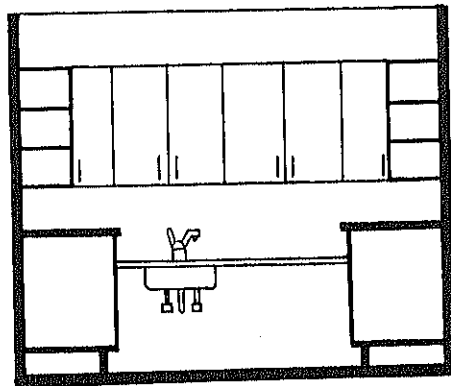
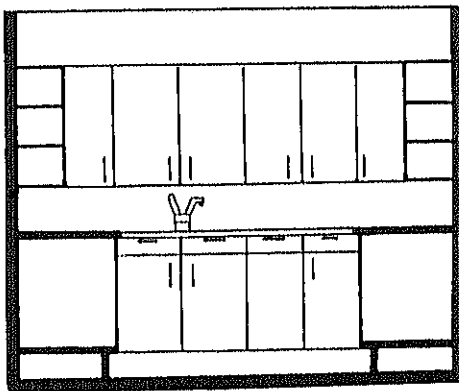
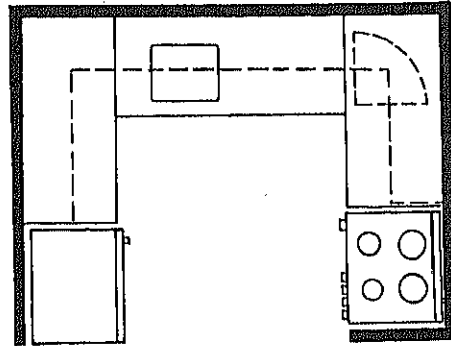
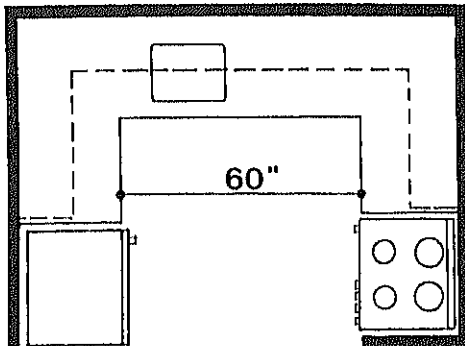
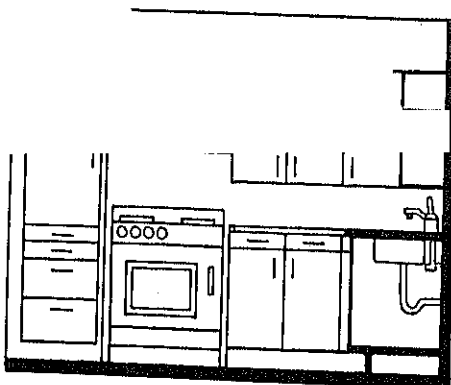
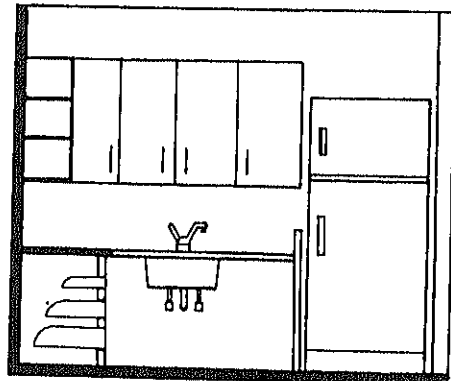
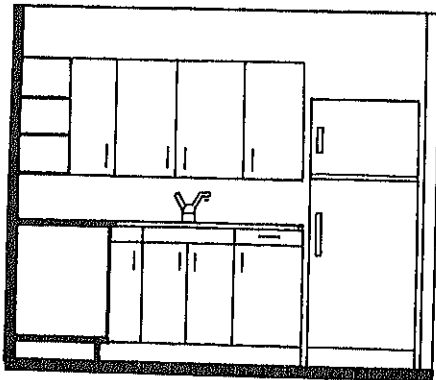
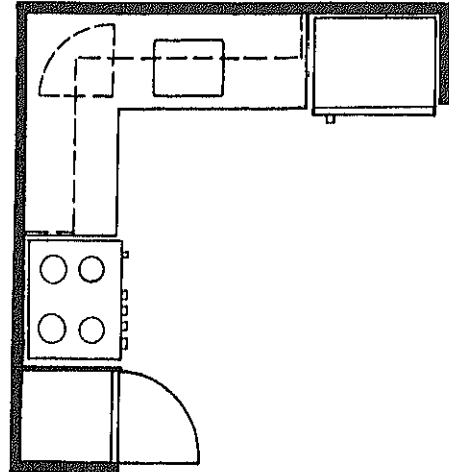
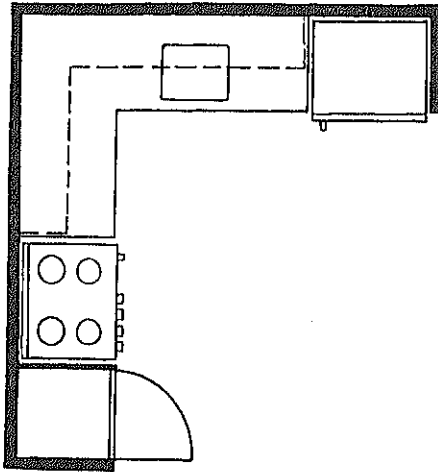


Figure 11: Exploded Axonometric for Adaptable Kitchen

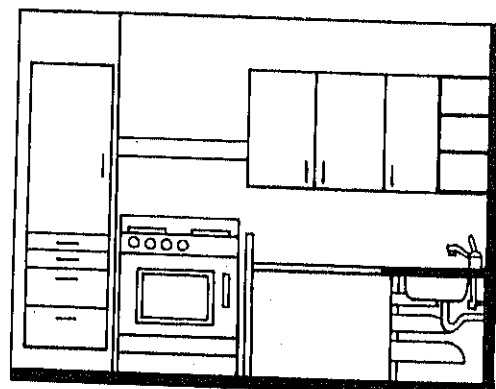


Accessible; before re-
moval of cabinets and
base.

Figure 12: Example of Adap



Accessible; before re-
moval of cabinets and
base.



Cabinets and base re-
moved, counter height
lowered.

Figure 13: Example of Adaptable Kitchen - L-Shaped Plan

kitchen would be conventional in appearance, before adaptation. The only difference would be that upper cabinets would be slightly lower (12 inch clearance to counter top instead of 15 inches) and that counter tops may have seams where the adjustable areas meet fixed areas. Conventional clearances for passage are sufficient (see Figs. 12-13).

4. Bathrooms

Recommendation: Bathrooms should have enough space for maneuvering wheelchairs, provisions for future installations of supports needed to transfer to and from toilets, bathtubs and showers, and fixtures at comfortable heights for use.

Discussion: Fixtures should be located with respect to walls and each other so that grab bars can be installed where needed. Clearances necessary to maneuver a wheelchair into a transfer position should be provided at each fixture. Structural reinforcement should be provided in the walls at places where grab bars and shower seats may be installed. Conventional toilets can be used with extra thick seats. Lavatories can be mounted at a fixed height with knee clearance underneath. Although shower stalls are preferred, bathtubs may be used since, as the preceeding section demonstrated, many people prefer bathtubs. Seats should be provided for bathtubs, either at the back or spanning the tub. Showers should be hand-held shower sprays that can also be mounted in a fixed position. Clearances required do not result in overly large bathrooms. Proper design can allow the use of conventional minimum-sized bathrooms that meet the design criteria (see Fig. 17). Since grab bars do not have to be provided, the only differences in appearance from conventional bathrooms would be hand-held showers and seats at the back or in bathtubs, both of which are highly marketable items.

5. Controls, Operable Hardware and Telephones

Recommendation: All controls, operable hardware be located within reach of a person who uses a

Discussion: This can be accomplished easily with from conventional practice. All that is required of locations to allow free space for positioning

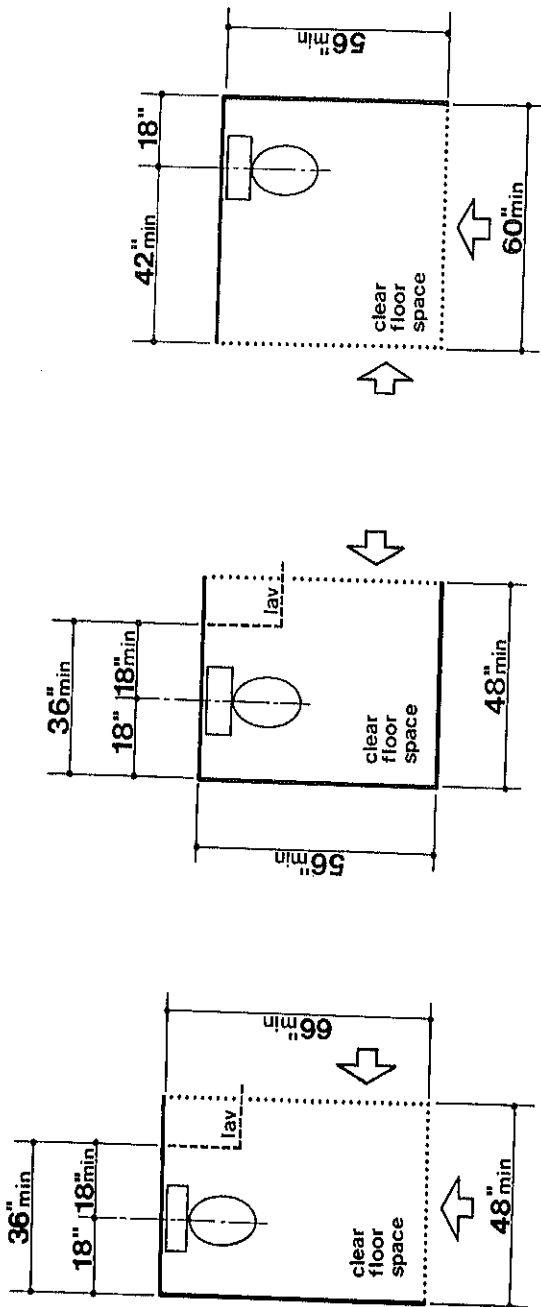
6. Closets and Bulk Storage

Recommendation: Bulk Storage areas and 50 percent in the dwelling unit should be within reach of

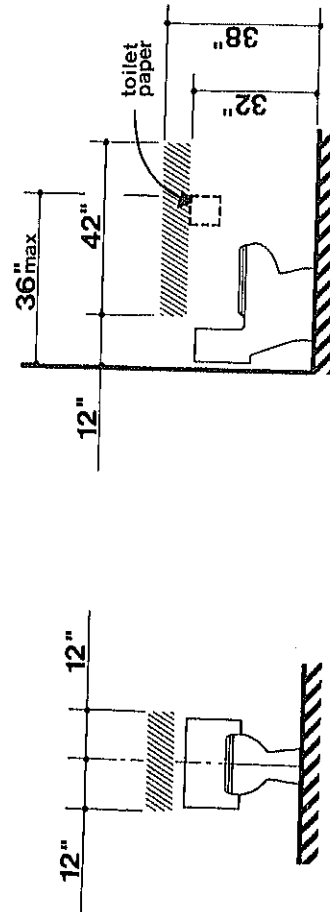
Discussion: This can be accomplished without conventional practice.

7. Alarm Systems

Recommendation: If audible emergency alarm system the unit should be equipped with all necessary install a visual emergency alarm system.

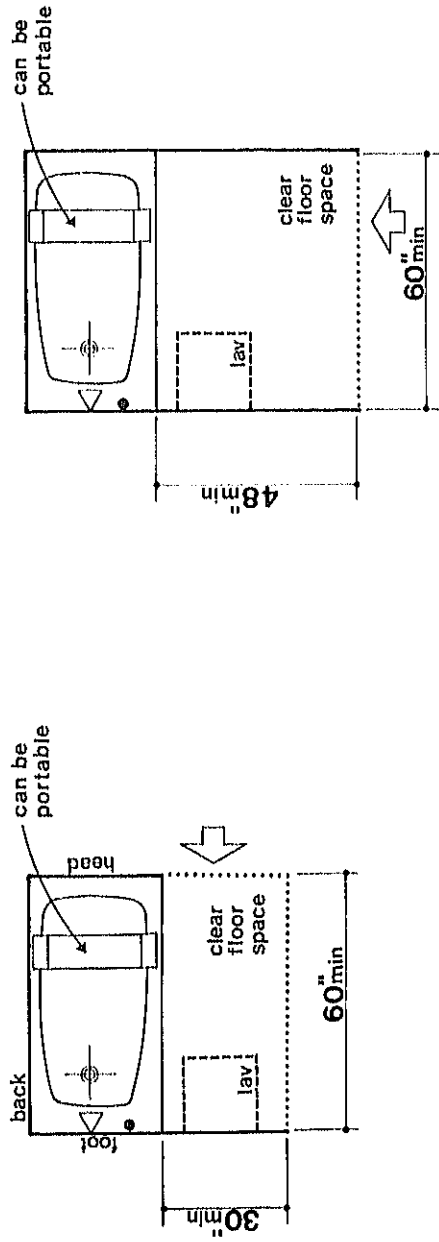


A. Clearances

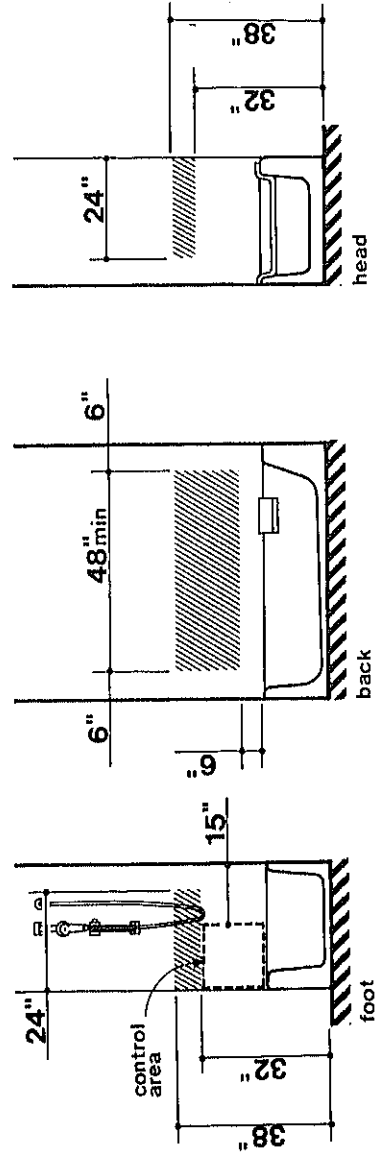


B. Structural Reinforcement Areas and Toilet Paper

Figure 14: Adaptable Toilets

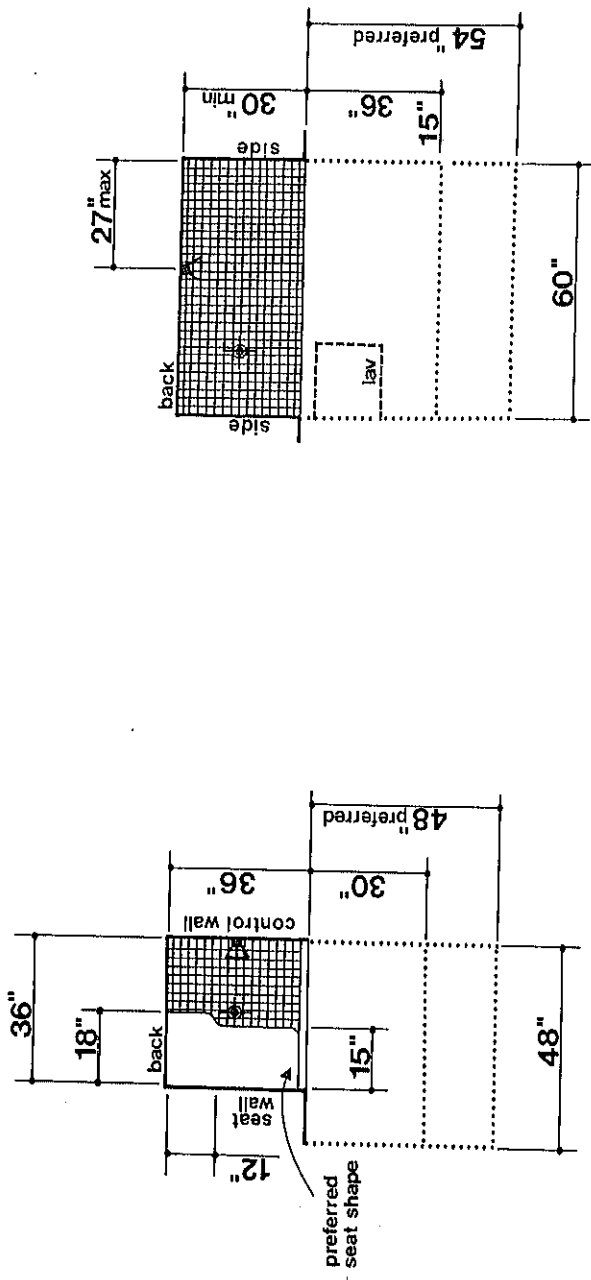


A. Minimum Clearances

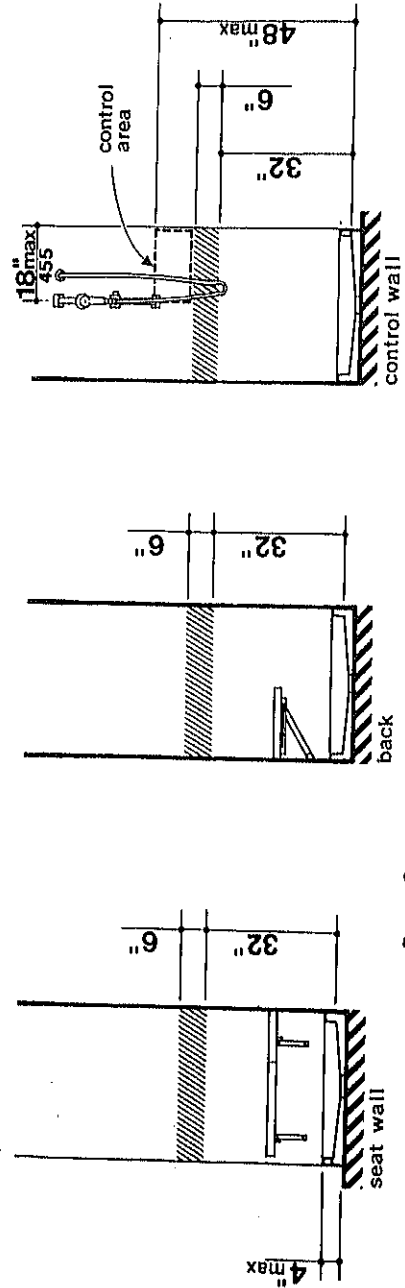


B. Structural Reinforcement Areas

Figure 15: Adaptable Bathtubs



A. Minimum Dimensions and Clearances



B. Structural Reinforcement Areas

Figure 16: Adaptable Showers

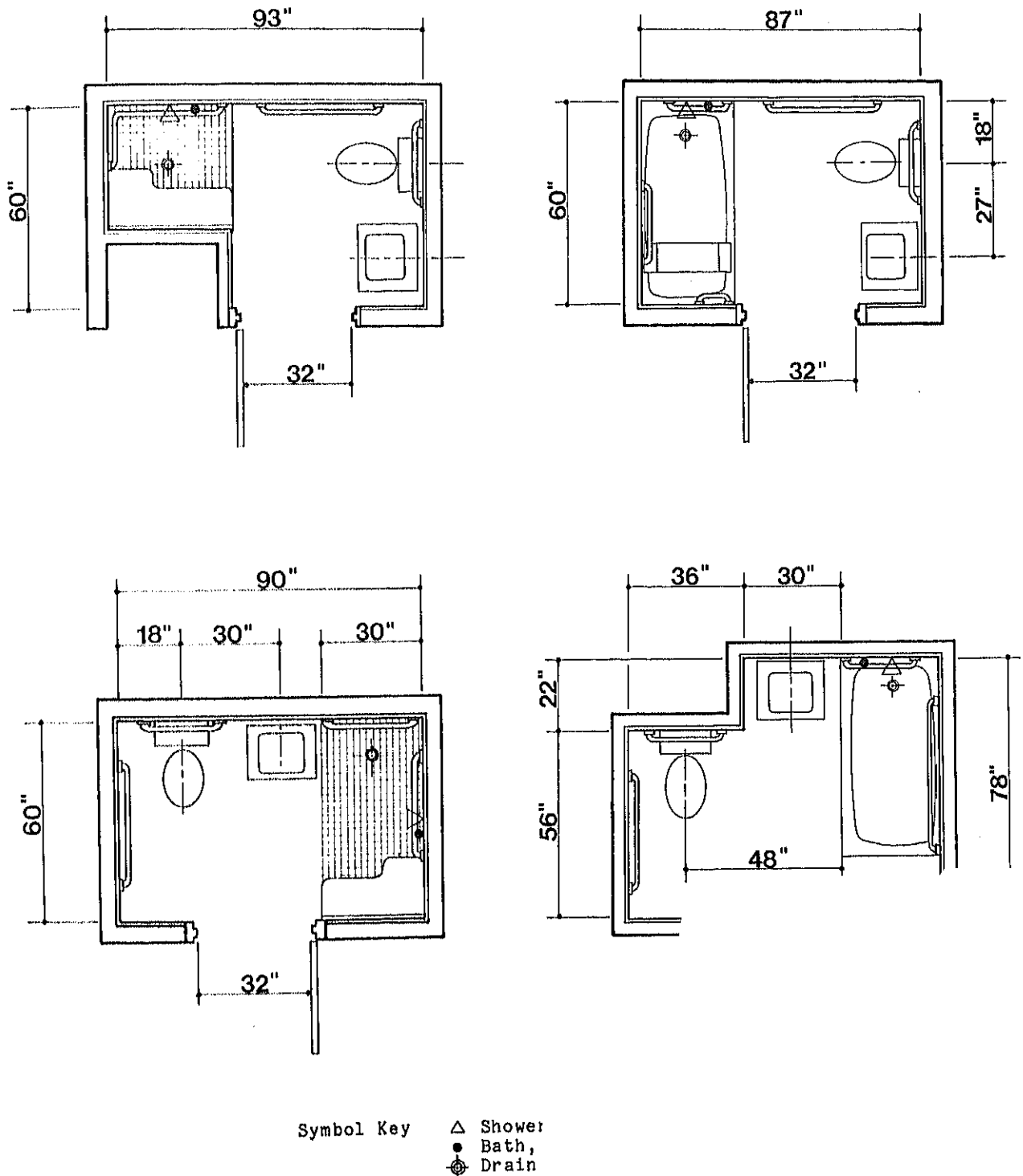


Figure 17: Minimum Size

Discussion: This only applies to alarms that are connected to the building power supply, e.g. fire alarms. Battery powered smoke alarms would not require wiring.

8. Building Products and Home Appliances

Recommendation: Electrical controls, plumbing fixtures and controls, home appliances, door and window hardware, windows, and floor surface materials should all be usable by people with disabilities.

Discussion: Most of these items can be selected from among those typically used in residential construction. Ovens that are usable by people with severe disabilities should be self-cleaning. These cost more than ovens usually found in low-cost housing, but are being used more in speculative housing. Lever-handle door handles can now be obtained at the same cost as door knobs. Moreover, they can be installed as replacement parts on conventional latch sets. Products and appliances that are usable by disabled people are also more convenient for able-bodied people and have high market appeal, e.g. single-lever faucet controls.

9. Impact on Usability

Beyond the minimum accessibility of the dwelling unit, in terms of space clearances, the concept of adaptable dwelling units would allow a person with a severe disability, e.g. a wheelchair user or blind person, to modify the dwelling unit with little cost. In fact, to install grab bars in the bathroom, remove cabinet fronts and lower counter tops at sink and mix center, could be done by the resident, a friend or the janitor for no labor cost. The only material cost would be to purchase grab bars. With professional labor, a full adaptation of a dwelling for a wheelchair user would cost about \$160 (Schroeder, et al., 1978). Most people would not require a full adaptation.

An adaptable dwelling unit provides a more responsive setting for exercising highly personal adaptations. As the consumer acceptance study demonstrated, disabled people do not want grab bars or openings under counters unless their specific condition warrants it. Moreover, they are often very creative in making adjustments to their dwelling units. The idea of adaptability fits well with such attitudes and abilities.

Furthermore, in units designed for families, the concept of adaptability recognizes that if only one family member is disabled, it is not always best to have an entire dwelling unit adapted to their needs. For example, if a husband or child is a wheelchair user and their wife/mother does all the cooking and dishwashing, it would be inconvenient for her to have counter heights at 28 or 32 inches-- good heights for wheelchair users.

Finally, this concept recognizes that able-bodied people may become severely disabled, either permanently or temporarily. The most important consideration here is in housing for the elderly, where having an adaptable dwelling unit may mean the difference between staying in their familiar living environment and relocating.

10. Impact on Cost and Marketability

Adaptable dwelling units would cost only slightly more than conventional dwelling units. The additional cost items can be summarized as follows:

Kitchen:

- A. Removable cabinet fronts at the mix center and sink.
- B. Counter tops that can be lowered at the mix center and sink.
- C. Self-cleaning or wall-mounted oven.

Bathroom:

- A. Structurally reinforced areas in walls next to toilets and surrounding bathtubs and/or showers.
- B. Wall hung toilet or thick toilet seat.
- C. Seat for a bathtub or shower.
- D. Hand-held shower.

Additional:

- A. Pre-wired electrical circuit to install visual fire alarm.
- B. Lever-handled door opener for entry door.

The cost of these items can vary, depending on the quality, manufacturer and labor costs. As a "ball-park" figure, the cost would probably be to \$250 (Schroeder, et al., 1978). It should be noted that several of the items increase the market value of a unit, specifically the hand-held shower, the self-cleaning oven and the seat in the bathtub or shower. Other, no-cost items would also increase the market value by providing greater overall convenience. For example, wider doors, lower shelves in cabinets and a lever-handle door opener on the entry door would have higher market appeal to most individuals; deliveries of furniture and other bulky items would be easier.

The provision of adaptability would not detract from the marketability of a dwelling unit since there would be no observable difference except the convenience features.

Finally, the problem of reserving accessible units for disabled people would not arise with the adaptable concept. Since some of the cost savings from A) eliminating lost income from a vacant unit, and B) eliminating special equipment and special cabinetry in a "handicapped" unit, could be redirected to the provision of more accessible units than otherwise would be provided. Thus, the units could be rented on a first-come, first-serve basis and, given enough adaptable units in a community, a disabled person should have little trouble finding one. The fact that all adaptable dwelling units in a multi-family building would be accessible to visitors who were disabled, would increase the possibilities of neighboring for a disabled person who lived in one of the units.

The circulation requirements for adaptable housing does restrict application of the concept to two story duplex apartments, townhouses and two story single family homes, unless a full bathroom, bedroom and second

bedroom or den are provided on the main floor, but the concept is easily applied to all other dwelling types.

References

- Access Chicago (Architects' and designers' handbook of barrier-free design). Chicago, IL: Rehabilitation Institute of Chicago.
- Anonymous. Teleoperators and human augmentation - New NASA publication. Journal of the American Geriatrics Society, XVI (July, 1969), 842.
- Building needs for the handicapped. Brattleboro, VT: Windham Southeast Supervisory Union, 1974-75.
- Cotler, S.R. and DeGraff, A.H. Architectural accessibility for the disabled on college campuses. Albany, NY: State University Construction Fund, October, 1976.
- Diffrient, N., et al. Humanscale 1/2/3. Cambridge, MA: MIT Press, 1974.
- Goldsmith, S. Designing for the disabled (3rd Ed.). New York: McGraw-Hill Book Company, 1967.
- Harkness, S.P. and Groom, J.N. Jr. Building without barriers for the disabled. New York: Whitney Library of Design, 1976.
- Jorgensen, J. Landscape design for the disabled. McLean, VA: American Society of Landscape Architects Foundation, 1975.
- Kliment, S.A. Into the mainstream. New York: American Institute of Architects, April, 1975.
- McCullough, H.E. and Farnham, M.B. Kitchens for women in wheelchairs (Circular 841). Champaign, IL: University of Illinois, College of Agriculture, September, 1972.
- Mace, R.I. An illustrated handbook of the handicapped section of North Carolina state building code (B. Laslett, Ed.). Raleigh: North Carolina Bldg. Code Council and North Carolina 1974.
- May, E.E., Waggoner, N.R. and Hotte, E.B. Independent 1 handicapped and the elderly. Boston, MA: Houghton M
- Neef, G. A study of the daily activities of ten homemakers in wheelchairs with the factors involved in their ability to perform their physical handicaps. Unpublished M.S. thesis. Cornell University, 1954.
- Occupational Therapy Department, Kenny Rehabilitation Institute making aids for the disabled. Minneapolis, MN: American Occupational Foundation, 1967.
- Olson, S.C. and Meredith, D.K. Wheelchair interiors. Cational Easter Seal Society, 1973.

- Rosenberg, C. Assistive devices for the handicapped. Minneapolis, MN: American Rehabilitation Foundation, 1968.
- Rusk, H.A. and Taylor, E.J. Living with a disability. New York: Doubleday and Co., 1953.
- Rusk, H.A., Kristeller, E.L., Judson, J.S., Hunt, G.M. and Zimmerman, M.E. A manual for training the disabled homemaker (3rd Ed.). New York: The Institute of Rehabilitation Medicine, 1967.
- Rusk, H.A. Mealtime manual for the aged and the handicapped. New York: The Institute of Rehabilitation Medicine, 1970.
- Schroeder, S., et al. The estimated cost of accessible buildings. Washington, DC: U.S. Department of Housing and Urban Development, 1978.
- Steinfeld, E., et al. Accessible buildings for people with walking and reaching limitations. Washington, DC: U.S. Department of Housing and Urban Development, 1978.
- Steinfeld, E. and Schroeder, S. Barrier-free design for the elderly and the disabled. Syracuse, NY: Syracuse University, All-University Gerontology Center and Center for Instructional Development, 1976.
- Tica, P.L. and Shaw, J.A. Barrier-free design: Accessibility for the handicapped (Pub. No. 74-3). New York: City University of NY, Center for Advanced Studies in Education, Graduate School and University Center, September, 1974.
- U.S. Dept. of Housing and Urban Development, Office of Policy Development and Research. Barrier-free site design. Washington, DC: U.S. Government Printing Office, April, 1975.
- U.S. Dept. of Transportation, Office of the Secretary. Travel barriers. Washington, DC: U.S. Government Printing Office, May, 1970.
- Wachter, P., Lorenc, J. and Lai, E. Urban wheelchair use: A human factors analysis. Chicago, IL: Access Chicago, Rehabilitation Institute of Chicago, April, 1976.
- Walter, F. An introduction to domestic design for the disabled. London, England: Disabled Living Foundation, December, 1969.
4. Planning kitchens for handicapped homemakers. New York: University Medical Center, Institute of Physical Medicine and Rehabilitation, 1965.
- Housing for the physically disabled. Seattle, WA: Able Associates, Inc.

